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Studies on Earthworms of Indiana and Illinois

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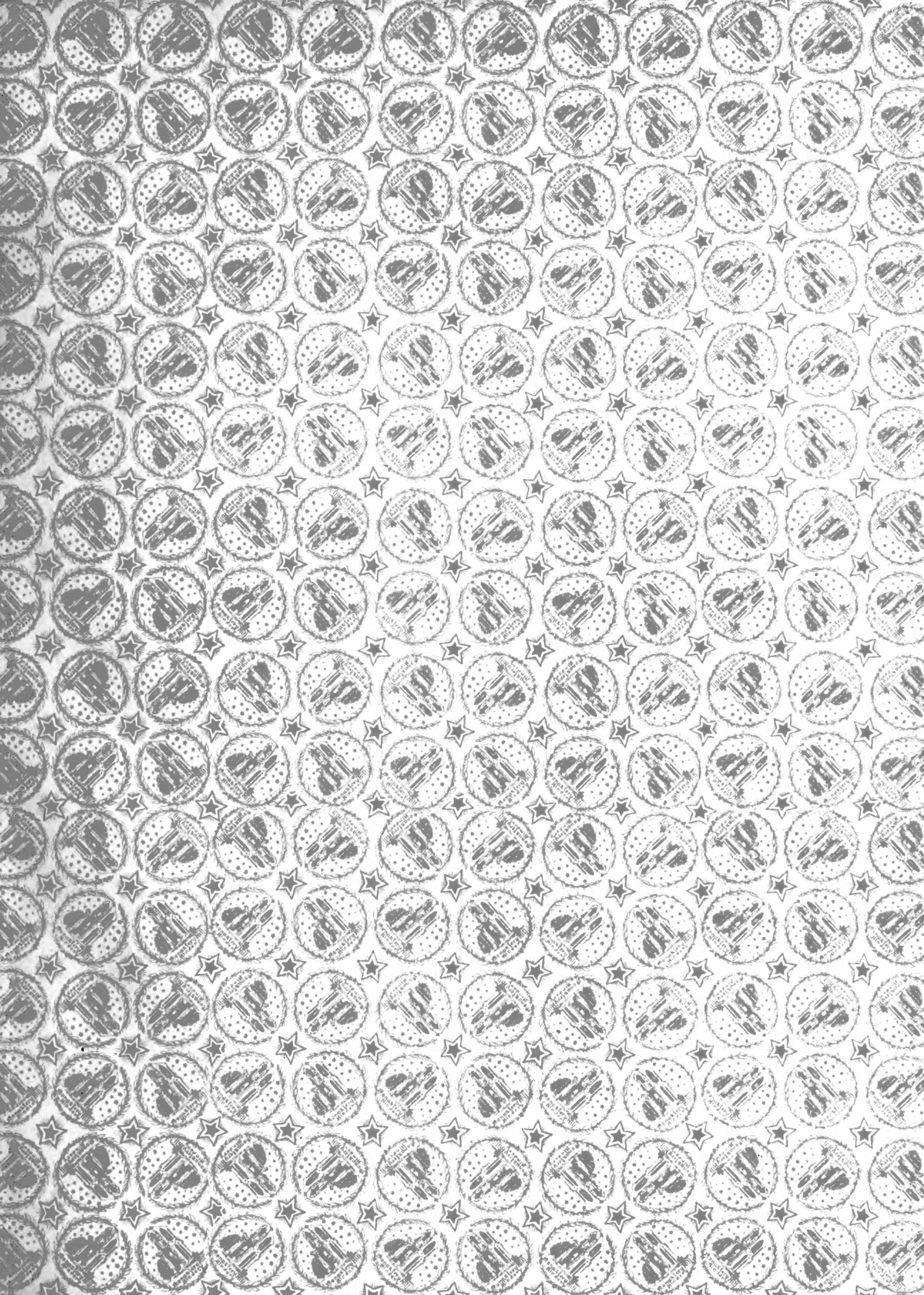

STUDIES ON EARTHWORMS OF INDIANA AND ILLINOIS

BY

HARRY VIRL HEIMBURGER

A. B. DePauw University, 1911

THESIS

Submitted in Partial Fulfillment of the Requirements for the

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IN

THE GRADUATE SCHOOL

OF THE

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I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY Harry Virl Heimburger

ENTITLED Studies on Earthworms of Indiana and Illinois

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE OF Master of Arts

Frank Smith
In Charge of Thesis

Head of Department

Recommendation concurred in:*

Committee on Final Examination*

*Required for doctor's degree but not for master's.

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STUDIES ON EARTHWORMS OF INDIANA AND ILLINOIS.

INTRODUCTION

Scope of Work and Source of Material.

This paper is an account of a systematic and faunistic study of earthworms of Indiana together with descriptions of a new variety and two new species of which one was found in Illinois. During the summer of 1914 the writer made collections of earthworms in six counties of Indiana. It was intended that a more complete collection should have been made but owing to the extreme drought of the summer it was practically impossible to do any collecting during July and August. The collections contain a number of species not previously reported for the state of which some are new to science. Very little has been done with this group of animals within the state and the literature of the group contains very few references to Indiana. In April 1914 the writer collected some earthworms near White Heath, Piatt county, Illinois among which is a specimen that forms the basis for the description of a new species from Illinois.

This work was done under the direction of Professor Frank Smith whose private library has made available a number of publications that have been of material assistance in these studies.

Methods and Technique.

All identifications were made from a study of living and preserved material and from serial sections. In most cases it was possible to compare this material with specimens from the collection of Professor Smith and in some cases either types or paratypes of the species were available. Sagittal sections from the anterior part of the worms are most useful in these studies. In making these sections about twenty anterior somites are split in the median sagittal plane and one half removed for sectioning the remaining part of the worm being preserved as an alcoholic specimen. The sections were stained with haematoxylin and eosin.

The material was fixed as soon after collecting as possible, no attempt being made to clear the worms of earthy matter

in the alimentary tract. The worms were anaesthetized by the chloroform method as follows. A few worms are placed in a little water in a Mason's fruit jar. A drop or two of chloroform is placed on a pad of blotting paper which is fitted into the cover of the jar. The cover is placed securely on the jar and the worms left for about half an hour when a few more drops of chloroform may be added and the worms left until fully anaesthetized. When the specimens do not respond to strong stimulation they are placed one at a time in the fixing agent and kept straightened until dead. Care must be taken not to add too much chloroform at first. If more than two or three drops are used in the beginning of the process the worms will be much irritated and may die in so contorted and contracted a condition as to be useless for sections. If only a little chloroform is used until the worms are partly anaesthetized this method gives as good results as chlorotone and requires less attention.

The fixing agent that was found most satisfactory for use in the field is a mixture of alcohol and formalin to make a four per cent solution of formalin in fifty percent alcohol. This solution requires no troublesome after treatment as the specimens may be left in the solution indefinitely or may be transferred later to eighty-five percent alcohol, which is the most desirable strength of alcohol for the preservation of such material. The alcohol-formalin mixture has an added advantage in that specimens which are left in it retain much of their natural color for several months. Specimens kept in this solution stain well with haematoxylin and eosin, but if material is desired for finer histological and cytological work, some of the corrosive sublimate preparations are better though these agents are rather troublesome to handle in the field.

Systematic and Geographic Relations.

The term Earthworms as used in this paper includes those Oligochaeta which belong to the four families; Moniligastridae, Megascolecidae, Glossoscolecidae and Lumbricidae. But three of these families are represented in our fauna, the Moniligastridae being limited to Borneo, Ceylon, Southern India and adjacent islands.

The Megascolecidae is the largest family of the group and probably originated during the early mesozoic. (Smith, '12: 146) This family is very widely distributed, chiefly in tropical regions and in the southern hemisphere. The genus Diplocardia is represented in our fauna and is known from Mexico, Lower California, Texas,

Florida, Nebraska, North Carolina and Illinois. This genus was first established by Garman (Garman, '88:47) for material obtained at Urbana, Illinois. My collections contain a number of specimens of Diplocardia from Indiana, most of which were collected late in the summer in Putnam and Vigo counties. As but few of these specimens are sexually mature the species cannot be determined with any degree of certainty. It seems evident, however, that there are new forms among them. A study of the Diplocardia species will be undertaken at a later time when it is hoped that more and better material may be at hand.

The family Glossoscolecidae appears to have developed in the northern continental region as early as the Jurassic. One genus of this family, Sparganophilus, is found in Mexico and various parts of the United States.

The family Lumbricidae is recognized as the most recent of the group and is derived from the Glossoscolecidae, probably in Southwestern Asia. (Michaelsen, '10:2) The family is thought to have invaded Europe in the Eocene and North America in the Oligocene. Most of the species found in America are European species of which many have been introduced in recent times through the agency of man. Several endemic species are known from the United States and undoubtedly others will be discovered by more extensive collecting. Michaelsen ('10:2-10.) recognizes three genera in this family all of which probably are represented in Indiana, though no representatives of the genus Lumbricus are yet known from the state.

INDIANA SPECIES

In the discussion of each of the Indiana species identified there is given a brief description or definition together with notes on the character of the locality and habitat in which the specimens were collected and a brief statement of the known range of the species. In all cases where Indiana is not mentioned in this statement of the range of species, it is believed that this is the first report of the occurrence within the state. Data concerning the geographical range of species were obtained chiefly from papers by Michaelsen. (See particularly, Michaelsen, '03.)

The following key for the identification of species includes several which have not been found in the state but which are known to occur in the eastern half of the United States and may be expected in Indiana. This key has been made from published descriptions and from a study of actual specimens of upwards of twenty of the

included species. Of some species no specimens were available but in such cases the original descriptions have been consulted. The key is based chiefly upon external characters, but in many cases satisfactory identifications cannot be made without a careful study of sections.

In the key and in other parts of the paper the roman numerals are used to designate somites. Symbols like V/VI indicate either septa or intersegmental grooves as shown by the context. The small letters a, b, c, and d indicate setae, ab being the ventral pairs and cd being the lateral pairs. When some structure is said to occur in line d or line cd_ etc, it is meant that the structure is in the longitudinal lines which would connect all of the setae d of either side or is between the parallel lines connecting all of the setae c and the setae d. Other terms used are those in general use in the literature of the group and are for the most part self explanatory. Following each of the definitions of species is a bracketed citation to literature in which a more extended account of the species may be found.

KEY FOR THE IDENTIFICATION OF SPECIES

1. Clitellum beginning anterior to XVI---------- 2
   Clitellum beginning posterior to XVI,
   Family, LUMBRICIDAE ---------- 12
2. Clitellum on XIII--XVIII. Prostomium epilobic.
   Family, MEGASCOLECIDAE
   Sub Fam. DIPLOCARDIINAE ---------- 3
   Clitellum on XV--XXV. Prostomium zygolobic.
   Family, GLOSSOSCOLECIDAE
   Sub Fam. CRIODRILIINAE ---------- 11
3. Pubertatic region on XVII--XX. Spermiducal pores on XIX -------- 4
   Pubertatic region on 1/4 XVIII--1/2 XXII. Spermiducal pores on XX. *Diplocardia verrucosa* (Ude)
4. Prostomium epilobic. Two pairs of sperm sacs---------- 5
   Prostomium tanylobic. Three pairs of sperm sacs.
   Diplocardia michaelseni Eisen.
5. Spermathecae, three pairs ---------- 6
   Spermathecae, two pairs (very rarely three pairs in *D. eiseni*)- 9
6. Dorsal vessel single ---------- 7
   Dorsal vessel double, except a few anterior somites.
   Sacculated intestine begins in XVII.
   Diplocardia communis Garman.

7. Gizzards in V and VI. Sacculated intestine begins in XVII. Spermathecal setae not modified. Size, less than 100 mm. long ---------- 8

Gizzards in VI and VII. Sacculated intestine begins in XVIII. Spermathecal setae modified. Larger, 275 mm long.

Diplocardia longa J. P. Moore.

8. Penial setae not ornamented. Paired pubertatic papillae on XVII and XX, sometimes also on XXI and XXII.

Diplocardia singularis (Ude).

Penial setae ornamented. Pubertatie papillae paired on XVII and XXI; median unpaired on XXII.

Diplocardia caroliniana Eisen.

9. Spermathecal setae not modified. Spermathecal pores anterior on VIII and IX in line ab. Sacculated intestine begins in XVIII. Dorsal vessel single. Last heart in XIII. 220--250 mm. long.

Diplocardia riparia F. Smith.

Spermathecal setae modified ---------- 10

10. Penial setae ornamented. Spermathecal pores anterior on VIII and IX in line b. Three pairs of elongated papillae on XVIII--XXI. Sacculated intestine begins in XVII. Dorsal vessel single. 70--90 mm. long.

Diplocardia udei Eisen.

Penial setae not well developed, not ornamented. Spermathecal pores posterior to a in line ab, usually two pairs on VIII and IX, occasionally three pairs on VII--IX. Pubertatic region on XVIII--XX, without papillae. Sacculated intestine begins in XVIII. Dorsal vessel double in part of somites VI--XV. 30--160 mm. long.

Diplocardia eiseni (Mchlsn).

11. Spermiducal pores on XIX, inconspicuous. Prostate-like glands in XXII--XXV or XXVI. Large coelomic glands opening anterior to ab in III and IV.

Sparganophilus eiseni F. Smith.

12. Prostomium epilobic ---------- 13

Prostomium tanylobic ---------- 31

13. Clitellum beginning anterior to XXX ---------- 14

Clitellum on XXX--XXXV.

Octolasium lacteum (Oerley).

14. Clitellum beginning anterior to XXIV ---------- 15

Clitellum beginning on XXIV or posterior to XXIV ---------- 19

15. Clitellum on XX--1/2 XXX. Tubercula pubertatis and spermathecae lacking. Sperm sacs in XI and XII.

Helodrilus gieselari (Ude).

Clitellum beginning posterior to XX ---------- 16

16. Clitellum on XXIII--XXXII. Tubercula pubertatis and spermathecae lacking. Sperm sacs in XI and XII.

Helodrilus longicinctus Smith and Gittins.

Clitellum beginning on XXII or XXIII. Tubercula pubertatis and spermathecae present ---------- 17

Clitellum beginning on XXII or XXIII. Tubercula pubertatis and spermathecae lacking ---------- 18

17. Tubercula pubertatis on XXIII or 1/2 XXIII--XXV or XXVI. Spermiducal pores on XIII, prominent.

Helodrilus tetraedrus typicus (Sav.)

Tubercula pubertatis as above. Spermiducal pores on XV.

Helodrilus tetraedrus hercynius (Mchlsn)

18. Clitellum on XXII--XXIX or 1/2 XXX. Spermiducal pores on XV, not especially prominent.

Helodrilus gieselari hempeli F. Smith.

Clitellum on XXIII--XXVIII. Spermiducal pores on XV, very large glandular prominence.

Helodrilus palustris H. F. Moore.

19. Clitellum beginning on XXIV, XXV, or XXVI ---------- 20

Clitellum beginning on XXVII, XXVIII, or XXIX ---------- 25

20. Spermathecal pores near dorsal median line ---------- 21

Spermathecal pores lacking or, if present, ventral to d ---- 24

21. Clitellum on XXIV--XXX. Tubercula pubertatis on XXVI--1/2 XXIX. Three pairs of spermathecae. Setae a and b of somites XXIV--XXX in papillae, modified into sexual setae.

Helodrilus lönnbergi (Mchlsn).

Clitellum on XXIV--XXXI. Tubercula pubertatis on XXVII--XXIX. Two pairs of spermathecae. ---------- 22

Clitellum on XXIV, XXV, or XXVI--XXXII or XXXIII ---------- 23

22. Spermathecae in X and XI.

Helodrilus carolinensis Mchlsn.

Spermathecae in IX and X.

Helodrilus carolinensis arboriculus n. var.

23. Tubercula pubertatis on XXVIII or 1/2 XXVIII--XXX or XXXI. Color; red, purple or brown with yellow rings at intersegmental grooves.

Helodrilus foetidus (Sav.)

Tubercula pubertatis on XXIX or XXX--XXXI. Color; flesh, no yellow rings, clitellum usually orange.

Helodrilus roseus (Sav.)

24. Spermathecae present. Clitellum on XXV, XXVI--XXXI or XXXII. Tubercula pubertatis on XXVIII--XXX. Two pairs of spermathecae.

Helodrilus subrubicundus (Eisen)

Spermathecae lacking ---------- 27

25. Clitellum on XXVII or XXVIII--XXXIV or XXXV ---------- 26

Clitellum on XXVIII or XXIX--XXXVII. Tubercula pubertatis three pairs of small sucker-like papillae on XXXI, XXXIII, and XXXV. Three pairs of spermathecae in IX, X, XI.

Helodrilus chloroticus (Sav.)

26. Tubercula pubertatis on XXXI and XXXIII. 60 to 160 mm. long.

Helodrilus caliginosus, typicus (Sav.)

Tubercula pubertatis on XXXI--XXXIII. 60 to 160 mm. long.

Helodrilus caliginosus trapezoides (Ant. Dug.)

Tubercula pubertatis on XXXI--XXXIV or 1/2 XXXV. 110 to 270 mm. long. Helodrilus longus (Ude)

27. Tubercula pubertatis present but indistinct ---------- 28

Tubercula pubertatis lacking (sometimes present, indistinct, in H. tenuis.) ---------- 29

28. Clitellum on XXIV--XXX. Tubercula pubertatis, indistinct, on XXV or XXVI--XXIX or XXX. 25 to 40 mm. long.

Helodrilus parvus (Eisen)

Clitellum on XXIV or XXV--XXXI or 1/2 XXXII. Tubercula pubertatis, indistinct, on XXV or XXVI--XXX. 17 to 46 mm. long.

Helodrilus beddardi (Mchlsn)

29. Clitellum on XXV--XXXIII ---------- 30

Clitellum not as above ---------- 31

30. Color, red. Spermiducal pores with slight glandular prominences. Modified setae on XV and XVI.

Helodrilus culverensis n. sp.

Pale, scarcely pigmented. Spermiducal pores with very large glandular prominence and with large atrial chamber. No modified setae.

Helodrilus moorei n. sp.

31. Clitellum on XXVI--XXXI. Sometimes with tubercula pubertatis very indistinct on XXVIII and XXIX; usually no trace of tubercula pubertatis. 20 to 50 mm. long.
Helodrilus tenuis (Eisen)

Clitellum on XXVII--XXXVII or XXXVIII. Tubercula pubertatis lacking. 70 to 140 mm. long.
Helodrilus zeteki Smith and Gittins.

32. Clitellum on XXVI or XXVII--XXXII. Tubercula pubertatis on XXVIII--XXXI.
Lumbricus rubellus Hoffm.

Clitellum on XXXI or XXXII--XXXVII. Tubercula pubertatis on XXXIII or 1/2 XXXIII--1/2 XXXVI or XXXVI.
Lumbricus terrestris Linn. Müll.

Notes on Indiana Species.

Sparganophilus eiseni Frank Smith.

Color, bluish or smoky gray. Prostomium zygolobic. Length, 180 mm. to 200 mm. Diameter, 2.6 mm. Clitellum on 1/4 XV--XXV dorsally; 1/2 XIV--XXVI ventrally. Tubercula pubertatis on 1/2 XVII--1/2 XXII. Spermathecal pores, three pairs, VI/VII--VIII/IX in line cd. Spermiducal pores on XIX close above the tubercula pubertatis. Setae closely paired: aa is less than bc; bc is less than dd; dd equals 1,1/2 aa anteriorly; dd equals 1,1/4 aa about middle of length. Sperm sacs, two pairs in XI and XII. Three or four pairs of prostate-like glands in XXIII--XXV or XXVI, opening near setae b. Large coelomic glands open in front of ab in III and IV.
(Smith, '95:142.)

This species is aquatic in habit, being found in mud of the borders of streams, ponds and lakes. Collected in large numbers in mud at the edge of a small stream near Kewanna, Fulton Co. and in mud and vegetable drift along the margin of Lake Maxinkuckee in Marshall Co. A few immature worms were taken later in the season on the roots of aquatic plants at Lake Maxinkuckee, in water of about eighteen inches in depth. While the determination of these latter specimens is not certain, they appear to be S. eiseni.

This species is known from Illinois, Michigan and Florida and

probably will be found generally distributed throughout the United States. (Smith, '15.)

Helodrilus tetraedrus typicus (Sav.)

Sienna brown, yellowish to red-brown, sometimes very dark. Length, 30 to 69 mm. Diameter, 2 to 4 mm. Somites, 65 to 100. Prostomium usually epilobic. Clitellum on XXII or XXIII--XXVI or XXVII. Tubercula pubertatis on XXIII or 1/2 XXIII--XXV or XXVI. Sperm sacs, four pairs, in IX--XII. Spermathecae, two pairs, in X and XI; pores VIII/IX and IX/X dorsal to d. Spermiducal pores on XIII, with large glandular prominences. Setae closely paired: aa equals bc; dd a little less than bc.

(Michaelsen, '00:473.)

This is an amphibious species, being found always in wet places, usually along the edge of streams or pools. Fifty-four specimens were collected at Lake Maxinkuckee, Marshall Co. in a mass of vegetable drift which was kept wet by the waves from the lake. No variation from the published descriptions was found in these specimens. About Urbana, Illinois this form has been found associated with H. tetraedrus hercynius Mchlsn. which variety is decidedly more abundant than typicus. These two varieties are distinguishable by the position of the spermiducal pores which, in hercynius, are on XV as usual for the Lumbricidae. Although this species was quite abundant at Lake Maxinkuckee, and the specimens were taken at random, there is in the collection not a single specimen of hercynius.

Distribution:

U.S;; Cal. Ills. Penn.

Wider; Canada. Chile. Azores. Canary Islands. Palestine. Syria. Europe(general). N. So. Wales. N. Zealand. Cape Colony.

Helodrilus foetidus (Sav.)

Red. purple or brown with yellow rings marking the intersegmental grooves. Length, 60 to 130 mm. Diameter, 3 to 4 mm. Somites, 80 to 110. Prostomium epilobic(1/2). Clitellum on XXIV, XXV, or XXVI--XXXII. Tubercula pubertatis on XXVIII or 1/2 XXVIII--XXX or XXXI. Sperm sacs, four pairs, in IX--XII. Spermathecae, two pairs, in X and XI; pores, IX/X and X/XI near dorsal median line. Spermiducal

pores on XV; glandular prominence on XV only. Setae closely paired, ornamented; aa equals bc, dd equals half the circumference.
(Michaelsen, '00:475.)

These are the common barnyard or manure worms, found in rotted manure or in well manured soil. Collected in large nnmbers in Marshall and Fulton Counties. It is probable that this species is to be found throughout the state. Near Kewanna, Fulton Co. this species was collected in an old abandoned clay pit into which a large amount of sewage is now being drained. In the wet ground along a sewage polluted stream and about a sewage polluted pond in this clay pit H. foetidus and H. caliginosus were very abundant. The H. foetidus which were taken in this locality are much larger than specimens taken from other places. The specimens in this collection are from 65 mm. to 130 mm. in length with the larger number more than 100mm. In the greatest diameter these worms measure 3mm. to 5 mm. more than half of the specimens being more than 4 mm. in diameter. The number of somites in twenty specimens is 88 to 110. The specimens collected at Culver, Marshall Co. were taken in very moist soil near an ice-house. The soil here was liberally mixed with decaying sawdust, straw, cinders and ashes. Worms from this locality measure: length, 55 mm. to 75 mm.; diameter, 2.5 mm. to 3 mm.; somites, 80 to 110. These specimens correspond in their dimensions to a few specimens that were taken from soil under a manure heap where there was not much moisture. It would appear from these facts that the optimum condition for this species is a very moist or wet soil in which there is an aboundance of animal excrement or organic matter of a similar nature.

Distribution:

U. S. :- Ariz. Cal. Ga. Ills. Mass. Ore. Wash. Wis.
Wider:- Canada. Mexico. Lower Cal. Europe (general). England. Asia (Siberia, Transcaucassus, Japan). Africa (Cape Colony). N. Zealand. Australia (N. S. Wales). Hawaii. Canary Islands. S. America (Chile).

Helodrilus roseus (Sav.)

Flesh colored or very pale, clitellum often deep orange color or yellow. Length, 25 mm. to 100 mm. Diameter, 3 mm. to 4mm. Somites, 120 to 150. Prostomium epilobic (1/2). Clitellum on XXIV, XXV or XXVI--XXXII or XXXIII. Tubercula pubertatis on XXIX or XXX--XXXI. Spermathecal pores, IX/X and X/XI near dorsal median line. Spermiducal pores on XV with small glandular prominences. Setae closely paired: aa greater than bc; dd equals half the circumference, anteriorly and one third the circumference posteriorly. ab or cd or both of somites IX and X and sometimes XII or XIII somewhat elongated and situated in rather prominent papillae. These papillae are sometimes lacking. Sperm sacs, four pairs, in IX--XII. Spermathecae, two pairs, in X and XI. (Michaelsen, '00:478.)

Specimens of this species were collected near Greencastle, Putnam Co. and near Terre Haute, Vigo Co. About thirty specimens are included in the collections of which the dimensions are:- length, 60 mm. to 100 mm.; diameter, 3 mm. to 4 mm.; Somites, 110 to 140. The dimensions as given by Michaelsen ('00:478) appear to be much too small for our H. roseus. The Indiana specimens are about the same size as is usual for this species about Urbana, Ills. The specimens were collected in a rather open woodland pasture and in a small piece of woods, the soil of both localities being a clay-loam and rather moist. This species is very abundant in the lawns at Urbana, Ills.

Distribution:-

U. S. :- Ariz. Cal. Ga. N. York. Ills. La.

Wider:- Africa and Asia (parts). Canary Islands. Europe, (general). Lower Cal. Mexico. So. America (Argentine, Brazil, Chile).

Helodrilus chloroticus (Sav.)

Color variable, green, yellowish green, reddish or flesh. Length, 45mm. to 100 mm. Diameter, 2.5 mm. to 5 mm. Somites, 80 to 125. Prostomium epilobic (1/2). Clitellum on XXVIII or XXIX--XXXVII. Tubercula pubertatis consisting of three pairs of small sucker-like papillae on somites XXXI, XXXIII, XXXV. Spermathecal pores, three pairs, VIII/IX--X/XI, in line cd. Spermiducal pores on XV, with large glandular prominences which encroach on XIV and XVI. Setae closely paired: aa greater than bc; dd equals half the circumference.

Sperm sacs, four pairs, in IX--XII. Spermathecae, three pairs, in IX--XI.

(Michaelsen, '00:486.)

Collected in Marshall, Putnam and Montgomery Counties, twenty-five specimens in all. These worms were taken in quite moist places in firm clay soil. In Marshall Co. the collections were made at the edge of Lake Maxinkuckee within reach of the wash of the waves. In Montgomery Co. this form was found in the wet clay soil at the margin of a small spring brook. In Putnam Co. the specimens were collected in moist clay in the bed of an intermittent stream. Length, 45 mm. to 100mm. Diameter, 2.5 mm. to 3.5 mm. Somites, 99 to 120. The color of all these specimens is a peculiar greenish ground color mottled with lighter patches. On being dug from the ground these worms would invariably curl up into a tight knot and remain inactive as long as handled.

Distribution:-

U. S.:- Cal. N. Carolina.

Wider:- Azores. Bermudas. Canary Islands. Europe (general). Greenland. Guatemala. Madeira. So. America (Chile, Uruguay). Syria.

Helodrilus caliginosus (Sav.) (Ant. Dug.)

Gray, flesh color, brown, yellowish or very pale, almost milky, sometimes very dark, almost black. Length, 60 mm. to 160 mm. Diameter, 4 mm. to 5 mm. Somites, 104 to 248. Prostomium epilobic(1/3). Clitellum on XXVII or XXVIII--XXXIV or XXXV. Tubercula pubertatis on XXXI and XXXIII or XXXI--XXXIII. Spermathecal pores, IX/X and X/XI in line cd. Spermiducal pores on XV, glandular prominences encroaching on XIV and XVI. Setae closely paired: aa greater than bc; dd equals half the circumference or is less than half the circumference. Setae a and b of IX, X, and XI are modified and located in broad, swollen glandular areas or pads. Broad glandular pads on XXXI, XXXIII and XXXV include the ventral setae, which are modified. Sperm sacs, four pairs, in IX--XII, those of IX and X smaller. Spermathecae, two pairs, in X and XI.

(Michaelsen, '00:482.)

Two varieties of this species are recognized, being distinguished by the nature of the tubercula pubertatis, which in the

form typicus (Sav.) are on XXXI and XXXIII, and in the form trapeziodes (Ant. Dug.) are continuous on XXXI--XXXIII. No specimens of typicus are included in the Indiana collections. Large numbers of trapezoides were found in Fulton. Marshall, Montgomery, Putnam and Vogo Counties. This is the most common earthworm in gardens and other cultivated areas wherever there is sufficient moisture. It is perhaps the most cosmopolitan of all the earthworm species and is said to be found wherever Europeans have settled and till the soil, in many places driving out the native species. Professor Smith thinks that about ninety percent of all the worms collected at random throughout the United States would be of this species.

Distribution:-

U. S.:- Ariz. Cal. Ga. Ills. Ind. Mass. Wis. Wash.
Wider:- Africa (Egypt, to Cape Colony). Asia (general). Canada. Canary Islands. Europe (general). Hawaii. Japan. Lower Cal. Mexico. N. Zealand. So. America, (Brazil, Bolivia, Argentine, Chile).

Helodrilus longus (Ude)

Smoky gray, highly iridescent. Length, 120 mm. to 270 mm. Diameter, 6 mm. to 8 mm. Somites, 160 to 200. Prostomium epilobic (1/3). Clitellum on XXVII or XXVIII--XXXV. Tubercula pubertatis on XXXII--XXXIV. Setae closely paired: aa greater than bc; dd less than half the circumference. Other characters as given for H. caliginosus, above.
(Michaelsen, '00:483.)

This species is very similar in all its diagnostic characters to H. caliginosus, the principal differences being in the much larger size and slight differences in position of clitellum and tubercula pubertatis. Michaelsen reports this species from Greencastle, Ind. near which place my own collections were made, Sept. 13, 1914. Nine specimens were taken in a moist ravine in woods. The soil is a black clay-loam. The length of these specimens is 172 mm. to 270 mm.; diameter, 4.5 mm. to 7 mm.; somites, 184 to 220. The clitellum of five specimens is located on XXVII--XXXV. On three specimens the position is XXVIII--XXXV and on one specimen the clitellum extends 1/2 XXVI--1/2 XXXVI, somites XXVI and XXXVI being included only on the dorsal side. The tubercula pubertatis on three specimens are on 1/2 XXXI--1/2 XXXV; on six specimens, 1/2 XXXI--XXXIV.

Distribution:-

U. S.:- Ind. Maine.

Wider:- Austria. Canada. England. France. Germany. Russia. Switzerland.

Helodrilus tenuis (Eisen)

Red dorsally, paler beneath. Length, 20 mm. to 50 mm. Diameter, 2.5 mm. to 3 mm. Somites, 90 to 105. Prostomium epilobic(2/3). Clitellum on XXVI--XXXI. Tubercula pubertatis usually lacking, sometimes present but indistinct on XXIX and XXX. Spermiducal pores on XV with slight glandular prominences. Setae widely paired; bc greater than cd; cd greater than ab. a and p of XVI on papillae. Sperm sacs, two pairs, in XI and XII. Spermathecae lacking.

(Michaelsen, '99:503.) (Smith, '14:364) (Smith, '15)

Collected in Fulton and Marshall Counties under logs in woods and in soil near an ice-house. Most of the Indiana specimens show no trace of tubercula pubertatis but a few have these structures showing indistinctly on XXIX and XXX. Two specimens have the tubercula pubertatis extending from 1/2 XXVIII through XXX, and these latter specimens are in no other way distinguishable from those having no tubercula pubertatis. Professor Smith has specimens both with and without the tubercula pubertatis, which were collected under the same rotted straw heap in Steuben County, Ind.

Distribution:-

U. S.:- Cal. Ills. Mich. Penn.

Wider:- Guatemala. Hawaii. Mexico. Russia. Turkestan. So. America (Argentine, Chile, Peru, Patagonia, Terre del Fuego). Unalaska.

Helodrilus dieseleri hempeli F. Smith.

Reddish above, paler beneath. Length, 65 mm. to 75 mm. Diameter, 2.5 mm. to 3.5 mm. Somites 105 to 115. Prostomium epilobic (1/2) Clitellum on XXII--XXIX or 1/2 XXX. Tubercula pubertatis lacking. Spermiducal pores on XV with slight glandular prominences. Setae closely paired: ab equals 1, 1/3 cd; aa slightly greater than bc; dd equals about half the circumference. Spermathecae lacking. Sperm sacs, two pairs, in XI and XII.

(Smith, '15:551.)

Four specimens were collected in woods under logs near Culver, Marshall Co., Ind. None show any trace of tubercula pubertatis. One specimen has the clitellum on XXII--XXVIII. Two specimens have the clitellum on XXII--XXIX and one specimen, 1/2 XXI--XXIX. In this last specimen the clitellum is distinctly thinner on XXI and includes this somite on the dorsal side only.

Distribution;- Illinois.

Helodrilus zeteki Smith and Gittins.

Purplish chestnut above, slightly paler beneath. Length, 70 mm. to 140 mm. Diameter, 5 mm. to 7 mm. Somites 100 to 142. Prostomium epilobic (1/3 to 1/2). Clitellum on XXVII--XXXVII or XXXVIII. Tubercula pubertatis lacking. Spermiducal pores on XV, with small glandular swellings. Setae closely paired: ab equals cd; aa a little greater than bc; bc equals 1/4 dd; dd equals half the circumference. Spermathecae lacking. Sperm sacs, two pairs, in XI and XII.
(Smith and Gittins, '15:545.)

Collected in Fulton and Marshall Counties in soil under logs and under the bark of decaying logs. Forty specimens were taken June 17, 1914 in a small piece of woods near Kewanna, Fulton Co. at which time the cocoons of this species were very abundant. No other earthworms were found in these woods except a few specimens of a small Diplocardia. A description of H. zeteki is now in press and as the cocoons have not been described a description is given herewith.

Twenty-three cocoons were preserved intact and a number were opened, the embryos being preserved in a straightened condition. The cocoons measure 4 mm. to 7 mm. in length and 3mm. to 5.5 mm. in breadth. In color they vary from pale straw color to brown, becoming darker with age. In the older cocoons the young worms may be seen moving about. From two to six embryos are contained within a cocoon. The more advanced embryos are a dark flesh color, with a slight reddish tint at the anterior dorsal part. These embryos are from 20 mm. to 27mm. in length and 1 mm. in greatest diameter. The somites number from 135 to 143. Younger embryos have only the anterior somites developed with the unsegmented portion open along the dorsal median line. Only an incomplete series of embryos is at hand and while some of these have been sectioned no detailed study of the embryology of this form has been undertaken. This species is known from Illinois and Michigan.

Octolasium lacteum (Oerley)

Bluish gray, milky, occasionally reddish brown; the clitellum yellowish or sometimes deep orange. Length, 40 mm. to 135 mm. Diameter, 3 mm. to 5 mm. Somites 100 to 165. Prostomium epilobic (1/3 to 2/3), occasionally tanylobic. Setae widely paired: usually ab is equal to or greater than bc; bc is greater than cd. Clitellum on XXX--X XXXV. Tubercula pubertatis on XXXI--XXXIV, sometimes encroaching on XXX and XXXV. Spermathecal pores, two pairs, IX/X and X/XI in line c. Spedmiducal pores on XV with large glandular prominences which usually encroach on XIV and XVI. Testes enclosed in the sperm sacs, in X and XI. Sperm sacs, four pairs, in IX--XII.

(Michaelsen, '00:506,)

This species is abundant in moist woodlands, in banks of ditches and streams and in other moist situations, though I have never found it in submerged soil. It is frequently found in localities which are submerged during high waters. Collections were made in Fulton, Marshall. Madison, Montgomery, Putnam and Vigo Counties. The species is porbably to be found throughout the state. Most of my specimens are longer than the upper limit given in Michaelsen's definition cited above, but in all diagnostic characters these specimens conform to the published descriptions. The largest specimen is 135 mm. in length, 6 mm. in diameter and the somites number 153.

Distribution:-

U. S. Reported from Illinois, only.

Wider:- Azores. Europe (general). Mexico. Russia. Uruguay.

DESCRIPTION OF NEW FORMS.

Helodrilus carolinensis arboriculus. var. n.

Definition.

Chestnut brown with violet iridescence dorsally, paler laterally and ventrally. Length, 55 mm. to 78 mm. Diameter, 3.5 mm. to 5 mm. Somites 120 to 130. Prostomium epilobic (1/2). Clitellum on XXIV--XXXI. Tubercula pubertatis on XXVII--XXIX. Setae closely paired: aa : bc : dd : ab : cd ; circumference = 55 : 40 : 80 : 6 : 7 : 241. Papillae on XII, XVII and XXV--XXXI including setae a and b which are elongated and modified in form. Spermathecal pores, IX/X and X/XI

very near the dorsal median line. Spermiducal pores on XV, with slight glandular prominences. Testes, two pairs, free in X and XI. Ovaries, one pair in XIII. Spermathecae, two pairs, dorsal in IX and X. Sperm sacs, three pairs, one each in IX, XI and XII. Calciferous gland with greatest enlargement in XII and with about 60 lamellae or partition running the length of the gland. Gizzard in XVII and XVIII. Six pairs of "hearts" in VI--XI. Septa anterior to the gizzard somewhat thickened; V/VI, VI/VII and XIII/XIV much thickened.

Three specimens were collected, August 24, 1914, under logs in a moist woodland near Summitville, Madison Co. Ind. The soil here is rather firm and very dark and there was considerable moisture though the summer had been very dry.

External Characters.

The color of the living worms is a chestnut brown with violet iridescence dorsally, slightly paler laterally and ventrally. The preserved specimens measure 55 mm. to 76 mm. in length and 3.5 mm. to 5 mm. in diameter. The somites number 120 to 130. The prostomium is epilobic, extending through the first somite to about half the length of the somite. The clitellum is incomplete ventrally and is situated on somites XXIV--XXXI. The clitellum does not include setae b but lies slightly dorsad of these setae. The tubercula pubertatis lie along the ventral margins of the clitellum on somites XXVII, XXVIII and XXIX. These form on each side a rectangular patch which is slightly raised from the margin of the clitellum and is rendered more conspicuous by a slight difference in color. The setae are rather strong and are closely paired. A strip of cuticula was removed from just behind the clitellum and from the mounted bit of cuticula measurements of setal distances were obtained. The proportions are as follows:-
aa : bc : dd : ab : cd : circumference = 55 : 40 : 80 : 6 : 7 : 241.
the setae are entirely free from sculpturing or ornamentation of any kind. This form is rather striking in the large number of modified setae which are borne on rather prominent papillae. Such papillae are found enclosing the setae a and b of somites XII, XVII and XXV--XXXI. The papillae of XII are rather indefinite, having no sharp boundary and being about the same color as the surrounding tissues. The papillae of XVII and the clitellar somites are very prominent, being sharply raised from the surface of the somite and being of a lighter color than the surrounding tissues. These papillae of XVII are elongated, a single papilla enclosing each pair of setae. The papillae of the clitellar somites are smaller and almost circular in outline, there being a

separate papilla for each seta of the ventral pairs. (Plate I, Fig. 6.) The setae in all of these papillae are longer than the ordinary setae and are modified in form. (Plate I, Fig. 2.) A number of setae were extracted from their papillae and mounted in glycerine. These setae and some entire setae which showed in sagittal sections, have been measured and the dimensions are given in the table below.

Somite	Seta	Length	Diameter
VIII	b	.67 mm.	.0473 mm.
X	b	.65	.0425
XII	a	1.13	.0298
XVII	a	1.12	.0378
XVII	b	1.26	.0378
XXV	a	.893	.0330
XXVI	b	1.13	.0378
XXVIII	a	.836	.0378

The first dorsal pore is in the intersegmental groove V/VI. Two pairs of spermathecal pores are found in IX/X and X/XI very near the dorsal median line. The spermiducal pores are on XV midway between setae b and c. There is only a slight glandular prominence which is entirely included on XV. The oviducal pores are inconspicuous on XIV slightly dorsad of b.

Internal Characters

The buccal cavity extends through the first somite but only a short distance into II. The epithelial layer here is not distinctly different from the general hypodermis. In the anterior third of II the lining of the alimentary tract begins to be differentiated. The pharynx extends from this point through somites III and IV. The dorsal and lateral walls of this region are much folded, in sections giving the appearance of many small pockets. The floor of the pharynx is quite smooth. The thick muscle mass on the dorsal side of the pharynx has a very rich blood supply and in it there is imbedded a many lobed mass of cells which stain deeply with haematoxylin. The oesophagus extends from IV/V to XIV/XV. This portion of the digestive tube shows considerable differentiation in structure in the various regions. The lining of the anterior portion is comparatively smooth but farther back the epithelium is formed into papillae and the region in VII, VIII, and IX is quite strongly papillated. The calciferous gland region begins in X, the oesophagus being distinctly enlarged in the

posterior part of X and more strongly enlarged in XI and XII. In this region the lining on the canal forms longitudinal folds which project into the lumen and divide it into pockets. (Plate I, Fig.5.) There are about sixty of these folds in somites XI and XII This new from is peculiar in this region in that the largest diameter of the gland is in the more posterior somites, whereas it is more generally true in the genus that the greatest diameter of the gland is in X or XI. Another peculiarity and one more fundamental in nature, if real, is that the longitudinal folds appear to hang free in the lumen of the gland. Usually the edges of these folds are connected by the epithelial lining of the canal and the lumen of the oesophagus is separated from the pockets of the gland. Furthermore the lumen of the oesophagus is usually quite strongly ciliated in this region, but no cilia are present in these specimens. It is thought that this condition may be due to poor preservation of the specimens, for it was impossible to fix this material immediately after collecting and the worms were dead or nearly so, before they were placed in the fixing agent. Some parts of the specimens show signs of maceration and it may be possible that the lining of this portion of the alimentary canal has macerated away. More material will be collected during the summer of 1915 and these points determined. The alimentary tube becomes very narrow and constricted in XIV and the lumen of the canal is very narrow and tortuous. (Plate I, Fig. 1.) In somite XV the canal abruptly widens to form the crop which lies in XV and XVI. The gizzard is well developed and is located in XVII and XVIII. The typhlosole of the intestine begins about somite XX.

There are six pairs of "hearts" in somites VI--XI. The circulatory system shows the characteristics typical of the Lumbricidae. No peculiarities were observed in the nervous and nephridial systems. All of the septa of the anterior end back to and including XVI/XVII are thickened; V/VI, VI/VII and XIII/XIV being especially thick, the others only slightly thicker than ordinary septa.

One pair of ovaries and a pair of oviducal funnels are found in the usual positions in XIII. Two pairs of spermathecae are found in the dorsal portion of IX and X. These are simple ovoid sacks without diverticula. The long duct of each spermatheca extends backward to its pore. (Plate I, Fig. 1) Two pairs of testes and two pairs of ciliated spermiducal funnels are found in somites X and XI in the usual positions. The two sperm ducts of either side unite in the anterior part of XII. The ducts of each side then traverse somites XII, XIII, and XIV lying on the surface of the longitudinal muscle layer just beneath the peritoneum. In XV the ducts bend obliquely downward to the pores. There are

three pairs of sperm sacs, one pair in each of somites IX, XI and XII. In somite X only loose masses of sperm cells are found.

Affinities.

This form evidently stands very close to Helodrilus carolinensis Mchlsn. the position of clitellum and tubercula pubertatis being identical in the two forms. The papillae on the clitellar somites are similar though Michaelsen describes the papillae of H. carolinensis as being indefinitely bordered ("undeutlich begrenzten") whereas the papillae on these somites in the variety arboriculus are very definitely bordered. The papillae of X and XVI and the lateral papillae of XII which Michaelsen describes for carolinensis are entirely lacking in arboriculus. Michaelsen says nothing of the character of the setae which are located in these papillae so no comparison can be made at this point. In arboriculus these setae are all modified, being longer and of a form different from that of ordinary setae. H. lönnbergi Mchlsn. is very similar in the character of the setae except that they are described as "ornamented" and in my specimens the setae are entirely without ornamentation. H. lönnbergi differs also in the location of the clitellum and tubercula pubertatis. The three forms may readily be separated on the basis of the number and position of the spermathecae. H. lönnbergi has three pairs of spermathecae while the other two forms have but two pairs. H. carolinensis has the spermathecae located in somites X and XI while H. carolinensis, arboriculus has these organs in IX and X.

The differences in size and pigmentation and in setal modification together with the difference in position of the spermathecae afford sufficient ground for establishing arboriculus as an independent form. However, the coincidence in position of clitellum and tubercula pubertatis seem to place it so close to H. carolinensis that, in the absence of specimens for comparison, it appears best to place this new form as a variety of carolinensis. This seems all the more desirable in the light of the fact that Michaelsen's species was described from a single specimen and his description is quite brief and unaccompanied by any illustrations. The following table gives the principal characteristics involved in a discussion of the relations of the new variety to the closely allied species.

Table of Characteristics of H. carolinensis, arboriculus and Allied Species.

	Helodrilus lönnbergi Mchlsn	Helodrilus carolinensis Mchlsn	H. carolinensis arboriculus
Color	Violet brown dorsally and laterally.	Red to pale flesh. Only slight pigmentation.	Chestnut brown dorsally, paler laterally and ventrally.
Dimensions	L. 96 mm. D. 4--6 mm. Somites. 138.	L. 35. mm. D. 2--3 mm. Somites. 121.	L. 55--78 mm. D. 3.5--5 mm. Somites. 120--130.
Clitellum	XXIV--XXX.	XXIV--XXXI.	XXIV--XXXI.
Tub. Pub.	XXVI--1/4 XXIX.	XXVII--XXIX.	XXVII--XXIX.
Setae	Closely paired. Ornamented. aa greater than bc dd equals 1/2 circ.	Closely paired. aa greater than bc dd equals 1/3 circ.	Closely paired. Not ornamented. aa greater than bc dd equals 1/3 circ.
Modified Setae	a and b, XXIV--XX mod. 1.6 mm. long.	Not mentioned.	a and b of XII, XVII, and XXV--XXXI mod. Elongated.
Papillae	Enclosing a and b of XXIV--XXX.	Enclosing a and b of X, XVI, XVII, and XXV--XXXI. Lateral on XII.	Enclosing a and b of XII, XVII, and XXV--XXXI.
Spermathecal pores	Three pairs, VIII/IX--X/XI near dorsal med. line.	Two pairs, IX/X, X/XI near dorsal median line.	Two pairs, IX/X, X/XI near dorsal median line.
Spermathecae	Three pairs in IX, X, and XI.	Two pairs in X and XI.	Two pairs in IX and X.
Sperm sacs	Three pairs in IX, XI and XII.	Three pairs in IX, XI and XII.	Three pairs in IX, XI and XII.

Helodrilus culverensis n. sp.

Definition.

Red above, paler beneath. Length, 51 mm. to 68 mm. Diameter, 2 mm. to 3 mm. Somites, 114 to 120. Prostomium epilobic (3/4). Clitellum on XXV--XXXIII. Tubercula pubertatis lacking. Spermiducal pores on XV with large glandular prominences . Somites XIV, XV, and XVI swollen ventrally and laterally. Setae closely paired: *ab* a little greater than *cd*; *aa* greater than *bc*; *dd* equals half the circumference. Setae *a* and *b* of XV and XVI are modified, only slightly sigmoid, 2.5 times as long as ordinary setae. Spermathecae lacking. Sperm sacs, two pairs, in XI and XII. "Hearts" in VIII--XI. Gizzard in XVII and XVIII. Septa of V/VI--XIII/XIV thickened; V/VI, VI/VII and VII/VIII thickest. A large gland in connection with each of the modified setae of XV and XVI.

Two specimens were collected in moist soil under logs near Culver, Marshall Co. Ind. Both specimens have been sectioned and agree in characters.

External Characters.

The color of the living worms is dark red dorsally and paler red beneath. The color is more pronounced anterior to the clitellum. Posterior to the clitellum the darker red forms a narrow line dorsally. The preserved specimens measure 51 mm. and 68 mm. in length and from 2 mm. to 3 mm. in diameter. The somites number 114 and 120. The prostomium is epilobic involving the first somite for about three fourths its length. The clitellum in one specimen extends from half of XXV through XXXIII. On the other specimen the position of the clitellum is XXV--1/2 XXXIII. There is no trace of tubercula pubertatis. The first dorsal pore is in V/VI. The spermiducal pores are on XV between setae *b* and *c*. The glandular swellings surrounding these pores are large and encroach slightly on XIV and XVI. Somites XIV, XV, and XVI are swollen ventrally and laterally. The glands about the end of the sperm duct engage the entire floor of XV but encroach only slightly upon the neighboring somites. (Plate II, Fig. 5.)

The setae are closely paired. Setal distance *ab* is very little greater than *cd*;; *aa* is greater than *bc* and *dd* is equal to one half the circumference. Setae *a* and *b* of somites XV and XVI are modified into sexual setae and are about two and one half times as long as ordinary setae. (Plate II, Fig. 4.) These modified setae are but

slightly sigmoid. The tips appear to be grooved but there is no sculpturing. Connected with each of these setae is a large gland consisting of what appear to be long flask shaped cells grouped about a common sac or chamber which receives the secretion from all of the cells. It is impossible to trace out in the sections the long duct-like portion of each cell from the cell itself to the lumen of the gland. The lumen of the gland communicates by a short duct with the seta sac. (Plate II, Fig. 3.) These glands correspond very closely to the "setigerous glands" of H. palustris as described and figured by H. F. Moore. ('95, pl II.)

Internal Characters.

The alimentary canal exhibits no special peculiarities. The calciferous gland region extends through somites X--1/2 XIV. There are strong lateral enlargements in X and less prominent enlargements in XI, XII and XIII. There are about thirty-six lamellae or partitions running the full length of the gland. The lumen of this portion of the alimentary tube is quite strongly ciliated. In XIV is a narrow region in which the lumen of the canal becomes very narrow and tortuous and in which the "pockets" of the gland communicate with the lumen of the tube.. The cilia in this region are quite strong. The canal enlarges in XV and XVI to form the crop. The gizzard in XVII and XVIII has quite thick muscular walls.

The nervous, nephridial and circulatory systems have the type of structure common for the Lumbricidae. There is a pair of "hearts" in each of somites VIII--XI. All of the anterior septa including XIII/XIV are somewhat thicker than the septa farther back. Septa V/VI, VI/VII, and VII/VIII are more thickened than others.

The ovaries and oviducal funnels have the usual positions in XIII. A pair of large ovisacs is found projecting from XIII/XIV, into the cavity of XIV. There is no trace of spermathecae. The testes and spermiducal funnels occur in X and XI and have the relations typical for the genus. The sperm ducts from the two funnels of either side unite about the middle of XII to form the common duct of each side. The sperm ducts are not imbedded in the muscle layers in any part of their course. The glands about the spermiducal pores are well developed in XV but encroach only to a slight extent upon the neighboring somites. There are two pairs of sperm sacs, one pair in XI and one pair in XII as is usual for the Bimastus group of the genus.

Affinities.

Helodrilus culverensis must be classified with the Bimastus group of the genus because of the total absence of spermathecae and tubercula pubertatis and the presence of only two pairs of sperm sacs, which occur in XI and XII. Of the species belonging to this group, this new form most closely resembles such forms as H. tenuis(Eisen) in size, coloration and habit. In position of the clitellum and in the presence of modified setae on XV and XVI, H. culverensis is distinct from any of the known species of the Bimastus group. The position of the clitellum is identical with that of H. moorei which is described in the following pages. Following the description of this latter form is given a table of the principal characteristics of these two new forms and a related form.

Description of a New Species from Illinois.

Helodrilus moorei n. sp.

Definition:

Slight pigmentation, color mostly due to blood and contents of alimentary canal showing through the body walls. Length, 77 mm. Diameter, 2.5 mm. to 3 mm. Somites, 112. Prostomium epilobic (1/2). Clitellum on XXV--XXXIII. Tubercula pubertatis lacking. Spermathecal pores lacking. Spermiducal pores on XV, with very large glandular prominences encroaching on XIV and XVI. A very conspicuous invagination or "atrial chamber" at the spermiducal pores. Oviducal pores rather conspicuous on XIV. First dorsal pore on V/VI. Setae closely paired: ab slightly less than cd; aa equals bc; and is equal to about one fifth of the circumference; dd equals 2 aa. No modified setae. Spermathecae lacking. Sperm sacs, two pairs, in XI and XII. Testes free in X and XI. Ovaries in XIII. A pair of ovisacs in XIV. "Hearts", five pairs, in VII--XI. Calciferous gland in X--XIV. Crop, XV and XVI. Gizzard in XVII and XVIII.

A single specimen was collected April 16, 1914 near White Heath, Piatt Co., Ills., in the wet soil of the banks of a small stream which flows into the Sangamon River at this place.

External Characters.

There is almost entire lack of pigment in the skin, the slight reddish color being due to the blood showing through the body wall. The specimen after preservation measures 77 mm. in length and 2.5 mm. to 3 mm. in diameter. The greatest diameter is at the clitellum. The somites number 112. The prostomium extends about half the length of the first somite. The clitellum is on XXV--XXXIII and is nearly complete, including the ventral setae. There is no trace of tubercula pubertatis. The first dorsal pore is in the intersegmental groove V/VI. The spermiducal pores are on XV, between setae b and c. The glands about these pores are very greatly developed so that the external prominences extend for some distance forward onto XIV and back onto XVI. A large invagination at each pore forms an atrial chamber into which the sperm ducts empty. The cells of the glands apparently discharge their secretions into this atrial chamber. The oviducal pores are on XIV, slightly more ventral than the spermiducal pores, and are rather prominent. The relation of these pores is shown in Plate II, Fig.7. It will be seen that the spermiducal pores are apparently in the intersegmental groove XV/XVI and this relation is borne out by a study of sections as shown in Plate II, Fig. 8.

The setae are closely paired: ab is slightly less than cd; aa equals bc and is equal to about one fifth of the circumference of the somite; dd equals 2 aa. These measurements were taken from the region just anterior to the clitellum. No modified setae are present and the setae are entirely free from ornamentation.

Internal Characters.

The digestive system exhibits no essential differences from the usual structures in the genus. The buccal cavity extends through I and II. The pharynx is located in III and IV but is longer than the external dimension of these somites and pushes the septum IV/V far back. The oesophagus extends through V--XIV. The region in V--IX is quite strongly papillated. The calciferous gland begins in X and is most enlarged laterally in this somite. Smaller lateral enlargements are found in XI, XII, and XIII. There are about forty lamellae or partitions in the calciferous gland. In the posterior part of XIII the alimentary tube is abruptly narrowed and the lumen is reduced to a narrow, tortuous, strongly ciliated passage. This narrow portion of the oesophagus continues through XIV in which somite the "pockets"

of the gland communicate with the lumen of the canal by minute slit like openings. In the posterior part of XIV the tube widens to form the crop which lies in XV and XVI. The gizzard is in XVII and XVIII. The large intestine begins in XIX, its typhlosole first becoming noticable about XXII.

The circulatory, nephridial and nervous systems exhibit no noticable peculiarities of organization. There is a pair of "hearts" in each of somites VII--XI, those of XI being smallest and those of IX the largest. The first complete septum is between somites IV and V and is about as thick as septa posterior to the gizzard. Septa V/VI--XIV/XV are thicker than the posterior septa; IX/X--XIII/XIV being the thickest.

The ovaries and oviducal funnels are in the usual positions in XIII. The oviducts pass obliquely to the ventral side of XIV and open at the oviducal pores. Extending backward into XIV, with openings near the mouths of the oviducal funnels in XIII is a pair of rather large ovisacs. These organs are each formed by an evagination of the septum including a portion of the large, many folded rosette of the oviducal funnel. The ciliated portion of each rosette extends for a short distance into the mouth of the ovisac. The ovisac in this specimen contained three or four eggs and appears capable of distension sufficient to accomodate six or eight fully formed ova. Two pairs of testes and their accompanying spermiducal funnels are found in X and XI. The sperm ducts of the anterior funnels pass back on the surface of the longitudinal muscle layer through XI and XII. The ducts of the posterior funnels run beside these through XII, the two ducts of each side uniting about the middle of XIII to form the common ducts of each side which lead back to the spermiducal pores. These ducts are at no point in their course imbedded in the muscle layer but lie just beneath the peritoneum on the surface of the muscle layer. In XV the sperm ducts bend upward over the large prostate-like glands and open into the apex of the large atrial chamber of the pore. (Plate II, Fig. 8 and 9) The glands about this atrial chamber are especially large, involving a large part of the floor of XIV and all of XV and XVI. The structure of these glands as shown in sections corresponds very closely to the descriptions and plates of H. F. Moore for the similar glands of H. palustris. (Moore, '95) The hypodermis in the atrial region is either lacking or is very different from the general hypodermal layer. Spermathecae are entirely lacking. Sperm sacs are present in XI and XII only.

Affinities.

The presence of sperm sacs in XI and XII only and the total lack of spermathecae and tubercula pubertatis, are characters which ally this species with the Bimastus group of the genus Helodrilus. The presence of very large glands about the spermiducal pores together with the presence of an atrial chamber puts this species very close to H. palustris H. F. Moore. It has been possible to compare sections of the new species with sections of palustris and the two forms are found to be quite distinct. The atrial chamber is larger in the case of palustris and the new form lacks the"setigerous glands" which Moore describes for certain somites of palustris. There are other slight differences in several characters as indicated in the table which is given below. Helodrilus moorei is readily distinguished from any of the known species of the group being approached in character of the atrial chamber and development of glands about the atrial region, by no other species than H. palustris.

Table of Characters.

	Helodrilus palustris H.F.M.	Helodrilus moorei n. sp.	Helodrilus culverensis n. sp.
Color	Pale, slight pigmentation.	Pale, slight pigmentation.	Red dorsally, paler beneath.
Dimensions	L. 75 mm. D. 2 mm. Somites 80--100.	L. 77 mm. D. 2.5--3 mm. Somites 112.	L. 51--68 mm. D. 2--3 mm. Somites 114--120.
Prostomium	Epilobic (1/2)	Epilobic (1/2)	Epilobic (3/4)
Clitellum	XXIII--XXVIII.	XXV--XXXIII.	XXV--XXXIII.
Tub. pub.	No trace.	No trace.	No trace.
Setae	Closely paired. aa greater than bc. bc equals dd. dd 1/3 circumference ab less than cd.	Closely paired. aa equals bc. bc equals 1/2 dd. dd 2/5 circum. ab less than cd.	Closely paired. aa greater than bc. bc less than 1/2 dd. dd less than 1/2 circ. ab greater than cd.
Modified setae	None.	None.	a and b of XV and XVI.
Spermiducal pores	Very large glandular swellings.	Very large glandular swellings.	Glandular swellings much smaller.
Spermathecae	No trace.	No trace.	No trace.
Atrial chamber	Invaginated to about half the diameter of body.	Invagination slightly less than half diameter.	No atrial chamber. Very slight invagination at pore.
Sperm sacs	XI and XII.	XI and XII.	XI and XII.
"Hearts"	VII--XI.	VII--XI.	VIII--XI.
Thickened septa	V/VI--XIII/XIV about equally thickened. Not greatly thickened.	X/XI--XII/XIV thickest.	V/VI--VII/VIII thickest.

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EXPLANATION OF PLATES

Abbreviations.

a atrial chamber.
al alimentary canal.
c clitellum.
cg calciferous gland.
cm circular muscles.
cp pockets of calciferous gland.
dp dorsal pore.
g gland cells.
h hypodermis.
l lamellae of calciferous gland.
lg lumen of gland.
lm longitudinal muscles.
o lumen of oesophagus.
p prostomium.
s seta.
sd sperm duct.
sg "setigerous gland".
sm seta muscles.
sp spermatheca.
ss sperm sac.
tp tubercula pubertatis
♂ spermiducal pore.
♀ oviducal pore.

Plate I.

Helodrilus carolinensis aboriculus. n. var.

Fig. 1. Schematic sagittal section near median sagittal plane.

Fig. 2. Setae. (1) Seta b, somite VIII. (2) Seta a, somite XII. (3) Seta a, somite XVII. (4) Seta b, somite XVII. (5) Seta b, somite XXVI. (6) Seta a, somite XXV. (7) Seta a, somite XXVIII.

Fig. 3. Seta b of somite XXVIII drawn from cross section to show gland connected with the modified setae of clitellar somites. Glandular tissue indicated by stippling.

Fig. 4. Cross section through somite X, showing relation of spermathecal pores and dorsal pores.

Fig. 5. Cross section of calciferous gland in anterior part of somite XII, indication lamellae of gland.

Fig. 6. Ventral view of clitellar somites indicating tubercula pubertatis and papillae.

(All figures except 6 are camera drawings.)

Plate II.

Helodrilus culverensis n. sp.

Fig. 1. Ventral side of H. culverensis.

Fig. 2. Dorsal view of I showing prostomium.

Fig. 3. Seta b of somite XVI, showing "setigerous gland". Similar glands are present with both a and b of XV and XVI.

Fig. 4. Setae. (1) Seta b, somite XVI. (2) Seta a, somite XV. (3) Seta a, somite XX. (4) Seta b, somite XXV.

Fig. 5. Sagittal section through spermiducal pore. Glandular region represented by stippling.

Helodrilus moorei n. sp.

Fig. 6. Dorsal view of I and II, showing prostomium.

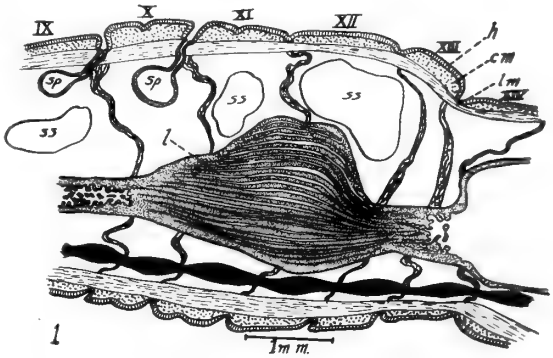
Fig. 7. Lateral view of somites in region of reproductive pores.

Fig. 8. Sagittal section through spermiducal pore, showing depth of atrial chamber. Glandular area indicated by stippling.

Fig. 9. Sagittal section through spermiducal pore, to indicate structure of glandular region.

(All figures except 1, 2, and 6 are camera drawings.)

PLATE I



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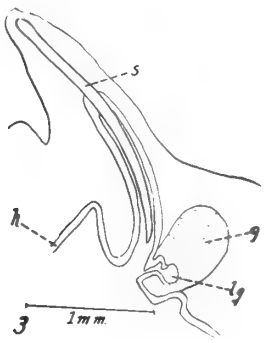

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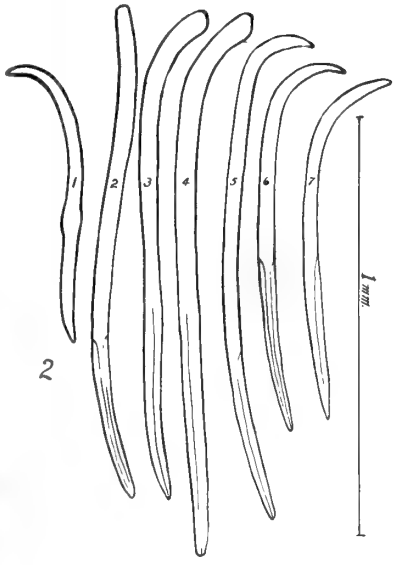

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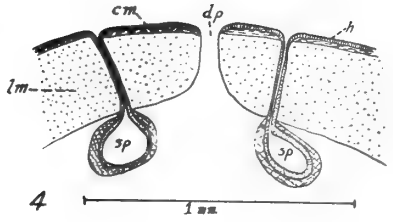

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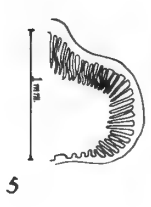

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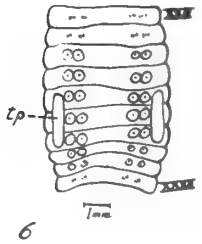

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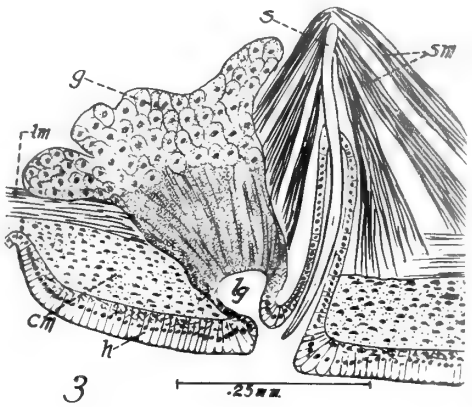
PLATE II



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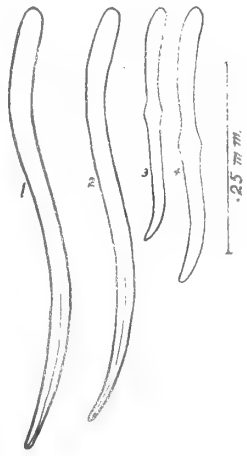

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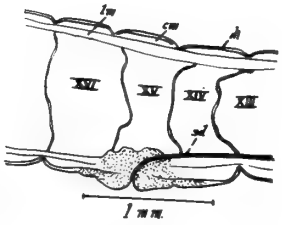

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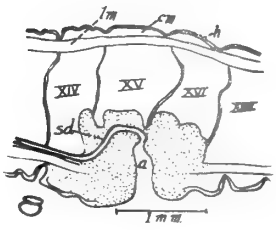

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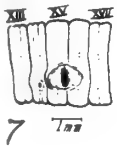

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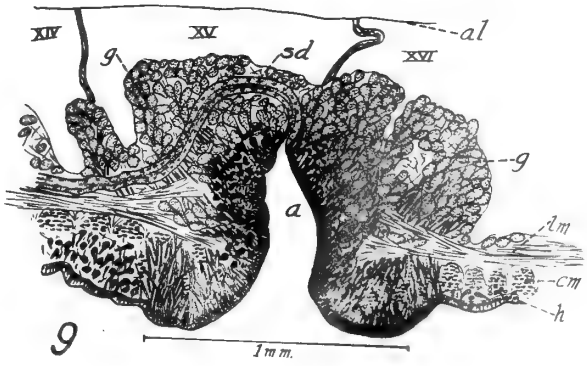

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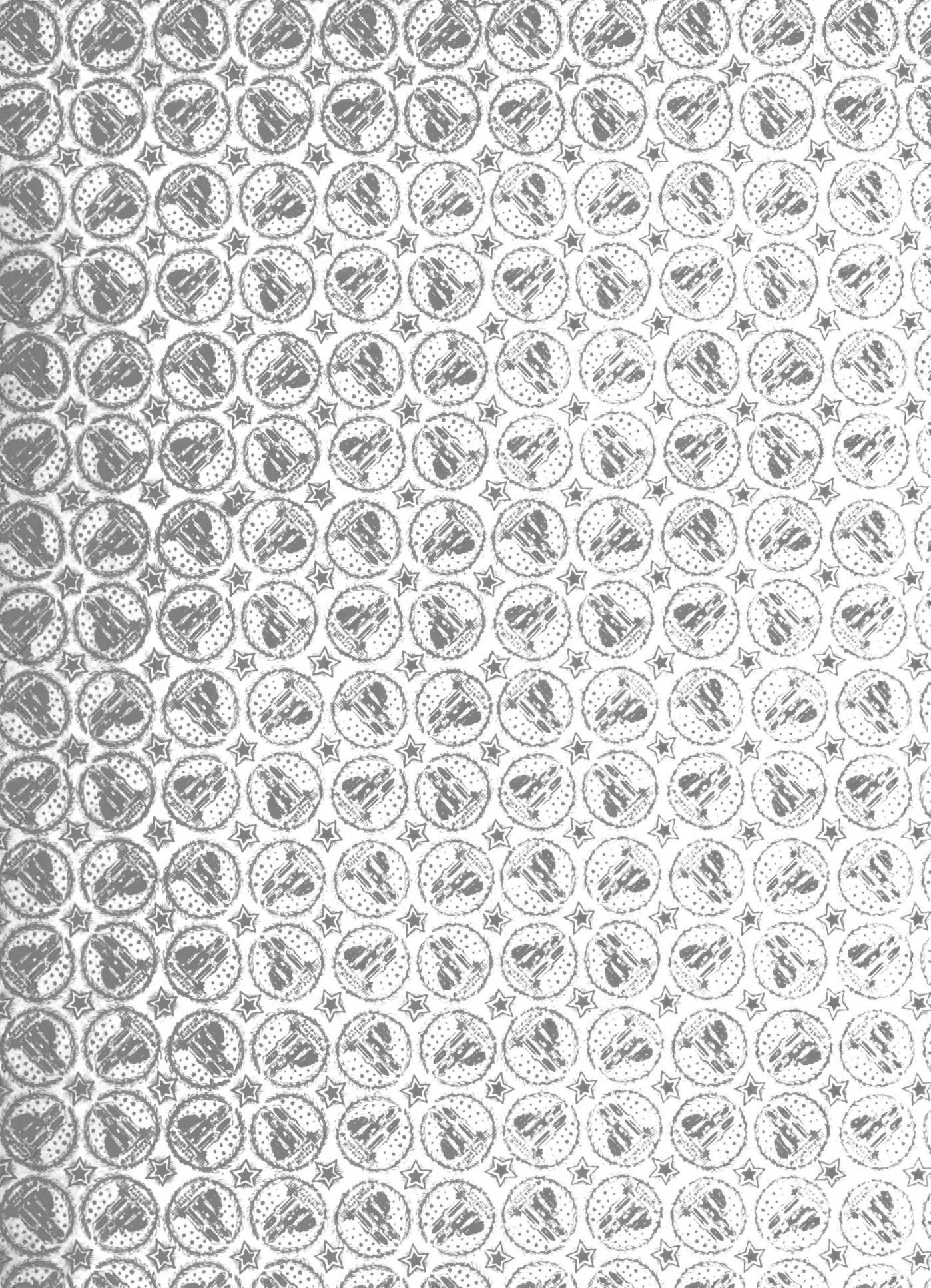

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